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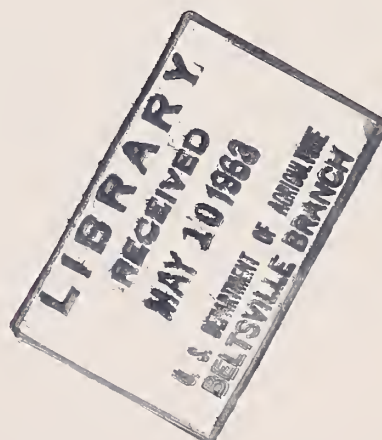
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CROWNVETCH

A Soil Conserving Legume and A Potential
Pasture and Hay Plant



Agricultural Research Service
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CROWN VETCH

A Soil Conserving Legume and A Potential Pasture and Hay Plant

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Crownvetch, Coronilla varia L., is a hardy, herbaceous, perennial legume. It is not a true vetch although it superficially resembles the vetches. The genus Coronilla comprises between 20 and 30 species native to Europe, Asia Minor, and North Africa, but primarily countries bordering the Mediterranean Sea. Various species, including C. varia, have been used chiefly as ornamentals in Europe.

In the United States crownvetch was used chiefly as an ornamental plant for many years. [There are a number of reports similar in context to that of Fraser (6) ^{2/} who said in 1897 that crownvetch is "a good plant to cover unsightly places as it will grow most anywhere." Commercial nurseries distributed plants and some seed from 1890 to 1930. This distribution accounts to a large degree for the occurrence of the species in small areas throughout the Central and Northern States.]

The value of crownvetch for erosion control has long been recognized. Numerous publications (7, 8, 16, 20) attest to its value for this purpose on highway embankments, spoil banks in strip-mined areas, and other sites where erosion is a serious problem.

Crownvetch is a long-lived perennial legume, which spreads by creeping underground root stocks. The stems are leafy, hollow and weak, ascend with support, and attain a height of 2 to 4 feet. The leaves are pinnate with 6 to 13 pairs of leaflets. The plant grows rapidly in the spring and matures a seed crop in midsummer. The flowers (fig. 1), borne in stalked umbels, are variegated in color, being white and shading to rose or violet. /

The flowers, as described by Muller (15) pp. 198-199, are very similar in structure to those of birdsfoot trefoil in that pollen is forced out through an orifice at the tip of the keel when pressure is applied to the keel. The seeds are tightly enclosed in articulated indehiscent pods.

Adaptation and Culture

² Crownvetch has been observed in small plot trials in many areas of the United States. It appears to be well adapted north of the 35th parallel of latitude from Oklahoma eastward. In general it grows best on well-drained

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^{2/} Underscored figures in parentheses refer to Literature Cited, at end of this report.



Fig. 1. Crownvetch in full bloom, June 8, 1962, Beltsville, Md.

soils. While excellent, persistent stands have been observed on moderately acid, rather infertile soils, more stands are not productive for hay or pasture without adequate fertilization and liming. Additional research is needed on fertility and lime requirements for establishing crownvetch for hay and pasture. Until additional studies are made, a fertility and liming program similar to that for red clover may be followed.

Inoculation: Since crownvetch is a relatively new legume, seed should be inoculated before planting. [According to Erdman (4), A specific strain of bacteria is required for proper inoculation. Specific directions for using crownvetch cultures, as found on the label of each container, should be followed in inoculating the seed.

Seeding: Crownvetch seed is hard and must be scarified before planting. Even with scarified seed, emergence and the seedling growth rate of the present varieties are very slow. Application of the fungicides thiram and captan to the seed before planting, is reported (9) to improve crownvetch seedling emergence in greenhouse studies. Once the seedlings are well established and in vigorous growth, relatively few plants per acre will result in good stands because of the spreading habit of growth due to the development of strong rhizomes. 2

Crownvetch was seeded in replicated plots with orchardgrass, tall fescue, and Kentucky bluegrass at Beltsville, Md., and was cut at the hay stage.

In general, stands of the mixtures have been poor. It is possible that a cutting procedure that would allow more late summer and fall growth would favor stronger development of the crownvetch plants. Establishment in pure stands has been more successful. When seedbeds are well prepared, firmed, and properly fertilized, satisfactory stands are usually established. Seeding 5 to 10 pounds of scarified, good quality seed 1/4 to 1/2 inch deep is recommended. The time required to get a productive stand will vary from 1 to 4 years, depending upon the kinds and prevalence of weeds and the extent to which they can be controlled. Clipping to remove tall-growing weeds is usually necessary. Good stands have been obtained by seeding in rows and cultivating the first year. Under good growing conditions, crownvetch will occupy most of the space between rows in the second year if not disturbed by cultivation (fig. 2).



Fig. 2. Crownvetch seeded in 40-inch rows, May 5, 1961. Photo taken November 2, 1961.

Preliminary tests by E. J. Peters and F. S. Davis for weed control in crownvetch ^{3/}showed that EPTC incorporated into the soil before seeding, or TCA and dalapon applied preemergence to the soil surface, controlled weed grasses and increased the number of plants established.

^{3/} Unpublished data of cooperative research between the Crops Research Division, ARS, U.S. Department of Agriculture, and the Missouri Agricultural Experiment Station. (In Annual Report 1958.)

Composition and Palatability: A number of reports (3, 5, 11, 13, 24) indicate that crownvetch is not well liked by grazing animals. These reports reveal that young growth is reasonably palatable but that more mature growth is unpalatable. The seed of crownvetch is reported to contain a toxic glycoside (17, 22, 23). Analyses of crownvetch hay show that it is comparable to other legume hays with respect to such properties as protein and crude fiber content. In cafeteria-type palatability trials, beef cattle have preferred other forage. A few farmers have reported good utilization and gains on crownvetch in relatively pure stands. No reports of animal losses from grazing this plant have been found.

The digestibility of crownvetch hay when fed to sheep has been determined in cooperative studies with the Animal Husbandry Division (12). The hay used in these studies was cut early in July, at a time when seed pods were forming on most of the plants. Results of a comparison of total digestible nutrient content of crownvetch hay and of No. 2 alfalfa hay on a 10-percent moisture basis, were 41.0 and 48.8 percent, respectively. If the quality of crownvetch hay declines with advancing maturity, as is true with many forages, these results show its digestibility to be surprisingly good.

Crownvetch contains considerable amounts of tannin. Samples of dried hay of various selections have ranged from 2 to 11 percent of tannin.^{4/} It is not known at present if these tannins are responsible for low palatability. If they do affect palatability and digestibility, as they do in sericea lespedeza, it is not surprising that animals refuse to graze the species readily.

Management: Specific tests to determine the most productive method of utilizing crownvetch for hay, pasture, or seed have not been conducted to date. When cut for hay at the full bloom stage, recovery is slow. An earlier first cutting may allow sufficient regrowth for a good second cutting without injuring stands. Studies are underway to determine the effects of number of cuts and time of cutting on yields and longevity of stands.

Tests to determine grazing methods and stocking rates for crownvetch have not been conducted. Its slow recovery rate when closely cut for hay indicates that the plant should not be completely defoliated by grazing animals. Continuous moderate to light grazing may be most suitable to maintain this species in a productive state.

Crownvetch is reported to be a nonbloating legume (8). If this is verified in more extensive tests, maintenance of grasses in association will not be necessary solely for the prevention of bloat. As more extensive pasturing studies are conducted, particularly with pure stands, animals should be closely observed for possible injurious effects over long periods of continuous grazing.

Varieties: The present varieties of crownvetch were developed and released primarily for erosion control on difficult sites such as road shoulders and steep slopes. Three varieties have been named and released.

^{4/} Unpublished data, Beltsville, Md., 1953.

Penngift (14) was named and released by the Pennsylvania Agricultural Experiment Station, University Park, in 1954. This variety is a local ecotype of the species first observed by F. V. Grau, Extension Agronomist of the Pennsylvania State University, Berks County, Pa., in 1935. In 1940 Grau collected and planted seed and crowns of this ecotype in a stony pasture in Centre County, Pa. This variety has been extensively tested for slope control by the Pennsylvania Agricultural Experiment Station in cooperation with the Pennsylvania Department of Highways, with seed produced by Grau, beginning in 1946. Grau and his associates were the first to produce sizable quantities of seed in this country.

Chemung was developed and released by the Soil Conservation Service at Big Flats, N. Y. (21). It is a composite of vigorous growing plants and lines that had been grown in that area for 15 years or more. It was named and released in 1960.

Emerald is a vigorous growing variety released by the Soil Conservation Service, U. S. D. A., and the Iowa Agricultural Experiment Station in 1962 (10). It has been widely tested in Iowa and adjoining States since 1938.

Comparative data on the adaptation and productivity of the three named varieties are not available. A limited number of test plots were established in cooperation with State experiment stations in 1961.

Improvement

Reports on any intensive breeding and improvement research on crownvetch have not appeared in the literature. Cyto-taxonomical studies of the genus *Coronilla* have been reported by Baksay (2), Polya (18), and Romanenko (19). These workers report crownvetch to be a tetraploid, having a $2n$ chromosome number of 24. Studies of strains and introductions at Beltsville, Md., in spaced nurseries have revealed wide variations within and between strains in vigor, plant type, number and fineness of stems, and maturity. Variation in tannin content is readily apparent, as determined by the quick test for tannin (12). The most vigorous plants were generally high in tannin, ranging from 7 to 11 percent. Plants of *sericea lespedeza* containing more than 7 percent of tannin are distinctly less palatable to grazing animals than are low tannin lines. The rate of growth of seedling plants of crownvetch is very slow. Many seedlings fail and 3 years or more may be required to produce satisfactory stands. When used for hay, recovery growth following cutting is usually slow, resulting in only 1 or 2 cuttings per year. Breeding objectives include (1) greater seedling vigor, (2) improved palatability, (3) more rapid recovery after cutting, and (4) greater productivity.

If a sound breeding program is to be initiated with crownvetch, knowledge of the breeding behavior of the species is necessary. Under field conditions crownvetch flowers at the same time as birdsfoot trefoil or a few days later. Attempts to bring crownvetch into flower during the winter in the greenhouse have not been too successful. Plants were brought into the greenhouse from the field in the fall of 1952, 1953, and again in 1960 and grown in light for 18 hours daily. Most of the plants failed to flower and those that did flower

produced only a few blooms per plant. Under the same conditions, plants of birdsfoot trefoil flowered profusely. In mid-December 1961, four plants were brought into the greenhouse for intercrossing in a special study. The plants flowered for a brief period, which permitted some crossing. Seed set was poor; many pods contained no seed. These preliminary results indicate that studies on the effect of photoperiod, cold treatment, and possibly light intensity or quality are needed before an intensive breeding program can be developed with this species. Anderson (1) conducted studies on the amount and weight of seed produced under cages with bees as compared to seed produced in the open. He concluded that the lowered light intensity under the cages was responsible for reduced yields and lighter seed weight.

Self-fertility: In June 1956 studies were initiated to determine the self-fertility of crownvetch under field conditions. Thirty-nine plants selected at random in a 1-year-old space-planted nursery were chosen for selfing studies. Single umbels were bagged in 2-pound brown paper bags just as the color began to appear in the flowers. Three or more umbels on each plant were bagged on June 4, 6, 11, and 18, 1956. All flowers were fully open and ready for pollination 4 days after bagging. Two methods of selfing were studied: (1) All flowers of each umbel were tripped with a toothpick and (2) each flower was gently rolled between the thumb and forefinger. Approximately one-third of the bagged umbels were left undisturbed. When self-pollinated, each umbel was tagged, and the method of selfing and the number of flowers selfed were listed.

All umbels producing pods were harvested approximately 30 days after pollination. The number of pods and seeds produced for each method of pollination is given in table 1.

TABLE 1. Flowers selfed and pods and seed produced by 3 methods of pollination.

Method of pollination	Flowers	Pods	Seed	Seeds per flowers selfed
	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>
Not tripped or rolled - - -	1,429	11	13	0.009
Rolled - - - - -	1,193	56	54	.045
Tripped - - - - -	1,141	71	86	.075

The results indicate that crownvetch is relatively self-sterile and that tripping individual flowers with a sterile toothpick is more effective in producing selfed seed than is rolling.

The plants differed in self-fertility. None of the plants in this study appeared to be highly self-fertile. The plants may be arbitrarily classified

into fertility groups such as (1) self-sterile, plants producing fewer than 3 seeds per 100 flowers selfed, (2) slightly self-fertile, plants producing from 3 to 9 seeds per 100 flowers selfed, and (3) moderately self-fertile, plants producing 10 or more seeds per 100 flowers selfed. The 39 plants are grouped on this basis in table 2.

TABLE 2. Plants in each self-fertility group, based on total seed produced from rolling and tripping flowers

Self-fertility group	Plants		Flowers selfed	Seed	Seeds per flowers selfed
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>
Self-sterile - - - - -	18	46	1061	7	0.007
Slightly self-fertile -	12	31	777	41	.053
Moderately self-fertile -	9	23	490	93	.190

While these data represent only a small number of plants, they also indicate that crownvetch is a relatively self-sterile species similar in this respect to birdsfoot trefoil.

Studies by Anderson (1) in Pennsylvania in 1957 and 1958 showed that crownvetch seed production depends on insects for pollination and that honeybees are the principal pollinators.

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